



**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

In re Patent Application of

LAGRANGE et al.

Atty. Ref.: 839-1383

Serial No. 10/774,400

TC/A.U.: 3745

Filed: February 10, 2004

Examiner: C. Verdier

For: ADVANCED FIRTREE AND BROACH SLOT FORMS FOR TURBINE  
STAGE 1 AND 2 BUCKETS AND ROTOR WHEELS

\*\*\*\*\*

February 5, 2009

Mail Stop Appeal Brief - Patents  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

**THIRD REPLACEMENT APPEAL BRIEF**

Sir:

Appellant hereby appeals to the Board of Patent Appeals and Interferences from  
the last decision of the Examiner.

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**(I) REAL PARTY IN INTEREST**

The real party in interest is General Electric Company, a corporation of the United States of America.

(II) **RELATED APPEALS AND INTERFERENCES**

The appellant, the undersigned, and the assignee are aware of the related appeal of patent application 10/774,399 filed on February 10, 2004 involving similar subject matter, naming the same inventors, and having the same assignee. Because the claims involved in the related appeal and the rejections thereof are obviously not identical to those involved in this appeal it cannot be conclusively predicted whether the related appeal will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

**(III) STATUS OF CLAIMS**

Claims 1-9, 11 and 21-28 have been canceled. Claims 10, 12-20 and 29-62 are pending and claims 10, 12-20, 29-45, 48-49, 52-53, 55-56 and 59-60 have been rejected and are being appealed. Claims 46, 47, 50, 51, 54, 57, 58, 61 and 62 have been deemed to contain allowable subject matter but are objected to as being dependent upon a rejected base claim. The Examiner has stated that the objected to claims "would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims." See, Final Office Action at page 25.

**(IV) STATUS OF AMENDMENTS**

An Amendment was erroneously filed on February 5, 2008, concurrently with an earlier version of this Appeal Brief, amending claim 29 to correct an antecedent basis problem identified by the Examiner in the Final Office Action. The Examiner did not enter that Amendment, and Appellant asks that the Board hold this issue in abeyance until this appeal is decided on the merits at which time Appellant will make any needed corrections in accordance with the Board's decision..

(V) **SUMMARY OF CLAIMED SUBJECT MATTER**

The invention of the claims relates to improved turbine buckets and wheel broach slots having dimensional relationships which reduce the number of buckets and corresponding wheel broach slots and the stresses acting on the buckets and wheel at the point of their attachment.

A listing of each appealed claim is given below including exemplary references to paragraph numbers of the specification and Figures of the application.

10. A turbine having multiple turbine stages, first and second turbine stages comprising:

a wheel [Fig. 1, ref. 10; Paragraph 28] having sixty broach slots [Fig. 1, ref. 12; Paragraph 28], each one of said broach slots having an interleaved system of fillets [Fig. 2B, ref. 31-33; Paragraphs 33-37] and tangs [Fig. 2B, ref. 28-30; Paragraphs 33-37]; and

a plurality of buckets [Fig. 1, ref. 11; Paragraph 28] each having a corresponding interleaved system of fillets [Fig. 2A, ref. 25-27; Paragraphs 29-32] and tangs [Fig. 2A, ref. 22-24; Paragraphs 29-32] so that said plurality of buckets [Fig. 1, ref. 11; Paragraph 28] can be fitted, one to one, into said sixty broach slots [Fig. 1, ref. 12; Paragraph 28] on said wheel [Fig. 1, ref. 10; Paragraph 28];

wherein said interleaved system of fillets and tangs on said buckets [Fig. 1, ref. 11; Paragraph 28] and wheelposts [Figs. 3A and 3B, ref. 13; Paragraph 38] act to reduce stresses acting on said fitted buckets and wheelposts, the fillets and tangs of said interleaved system of fillets and tangs each being formed by a combination of

curved and straight surfaces [Figs. 2A and 2B, ref. 22-24, 25-27, 28-30, 31-33; Paragraphs 29-37];

wherein the straight surfaces [Fig. 2A, ref. 202, 204, 205, 207; Paragraph 31] of each of the two uppermost tangs [Fig. 2A, ref. 22 and 23; Paragraph 31] on each side of a center line bisecting each of said buckets define two points of a respective line that form an angle of  $20.782^\circ$  with the center line [Fig. 2A, ref. 202, 204, 205, 207, Fig. 10, ref. E; Paragraphs 45, 48]; and;

wherein a point defined by intersecting tangent lines [Fig. 10, ref.  $T_1$ ,  $T_2$ ; Paragraph 48] along pressure faces of the bottom most tang [Fig. 10, ref.  $T_1$ ,  $T_2$ ; Paragraph 48] does not lie on either line that forms the angle of  $20.782^\circ$  with the center line [Fig. 10, ref.  $T_1$ ,  $T_2$ ; Paragraph 48].

12. A turbine as claimed in claim 10, wherein the fillets [Fig. 2A, ref. 21, 25-27; Paragraphs 29-32] formed on said plurality of buckets [Fig. 1, ref. 11; Paragraph 28] have angles ranging from  $50^\circ$  to  $57^\circ$  [Fig. 2A, ref. 201, 202, 204, 205, 207, 208, Fig. 9, ref. A, B, Fig. 10, ref. F; Paragraph 47].

13. A turbine as claimed in claim 10, each one of said buckets [Fig. 1, ref. 11; Paragraph 28] and wheelposts [Figs. 3A and 3B, ref. 13; Paragraph 38] having three interleaved tangs [Fig. 2A, ref. 22-24, Fig. 2B, ref. 28-30; Paragraphs 29-37] and fillets [Fig. 2A, ref. 25-27, Fig. 2B, ref. 31-33; Paragraphs 29-37].

14. A turbine as claimed in claim 13, wherein each of said buckets [Fig. 1, ref. 11; Paragraph 28] having a bottom tang [Fig. 2A, ref. 24] formed from curved



surfaces [Fig. 10, ref. R<sub>1</sub>, R<sub>13</sub>; Paragraph 54] having more than one radius of curvature [Fig. 10, ref. R<sub>1</sub>, R<sub>13</sub>; Paragraph 54].

15. A turbine as claimed in claim 14, wherein each of said buckets [Fig. 1, ref. 11; Paragraph 28] further includes at least one straight surface [Fig. 2A, ref. 201; Paragraph 30].

16. A turbine as claimed in claim 10, wherein each of said wheelposts [Figs. 3A and 3B, ref. 13; Paragraph 38] having a bottom fillet [Fig. 11, ref. 33; Paragraph 64] formed from curved surfaces having more than one radius of curvature [Fig. 11, ref. 33, Fig. 12, ref. R<sub>7</sub>, R<sub>7</sub>; Paragraph 64].

17. A turbine as claimed in claim 16, wherein each of said wheelposts [Figs. 3A and 3B, ref. 13; Paragraph 38] further includes at least one straight surface [Fig. 2B, ref. 217; Paragraph 34].

18. A turbine as claimed in claim 14, wherein said curved surfaces have radii of curvatures of .3762 inches and .5556 inches [Fig. 10, ref. R<sub>1</sub>, R<sub>13</sub>; Paragraph 54].

19. A turbine as claimed in claim 16, wherein said curved surfaces have radii of curvatures of .3822 inches and .5616 inches [Fig. 11, ref. 33, Fig. 12, ref. R<sub>7</sub>, R<sub>7</sub>; Paragraph 64].

20. A turbine as claimed in claim 10, wherein a top surface of each one of said wheelposts [Figs. 3A and 3B, ref. 13; Paragraph 38] being scalloped so as to reduce the weight of said wheel [Fig. 7, ref. 70, Fig. 8, ref. 70; Paragraph 40].

29. A bucket for insertion into a wheelpost of a turbine rotor, said bucket being formed from interleaved fillets and tangs which complement interleaved fillets and tangs formed in the wheelpost,

wherein said interleaved system of fillets [Figs. 2A and 2B, ref. 25-27, 31-33; Paragraphs 29-37] and tangs [Figs. 2A and 2B, ref. 22-24, 28-30; Paragraphs 29-37] on said buckets [Fig. 1, ref. 11; Paragraph 28] and wheelposts [Figs. 3A and 3B, ref. 13; Paragraph 38] act to reduce stresses acting on said fitted buckets [Fig. 1, ref. 11; Paragraph 28] and wheelposts [Figs. 3A and 3B, ref. 13; Paragraph 38], the fillets and tangs of said interleaved system of fillets and tangs each being formed by a combination of curved and straight surfaces [Figs. 2A and 2B, ref. 22-24, 25-27, 28-30, 31-33; Paragraphs 29-37];

wherein the straight surfaces [Fig. 2A, ref. 202, 204, 205, 207] of each of the two uppermost tangs [Fig. 2A, ref. 22 and 23] on each side of a center line bisecting each of said buckets [Fig. 1, ref. 11; Paragraph 28] and wheelposts [Figs. 3A and 3B, ref. 13; Paragraph 38] define two points of a respective line that form an angle of  $20.782^\circ$  with the center line [Fig. 10, ref. E; Paragraphs 45, 48]; and

wherein a point defined by intersecting tangent lines [Fig. 10, ref.  $T_1$ ,  $T_2$ ; Paragraph 48] along pressure faces of the bottom most tang [Fig. 10, ref. 24; Paragraph

48] does not lie on either line that forms the angle of  $20.782^\circ$  with the center line [Fig. 10, ref. T<sub>1</sub>, T<sub>2</sub>; Paragraph 48].

30. A bucket as claimed in claim 29, said bucket [Fig. 1, ref. 11; Paragraph 28] having three interleaved tangs [Fig. 2A, ref. 22-24; Paragraphs 29-32] and fillets [Fig. 2A, ref. 25-27; Paragraphs 29-32].

31. A bucket as claimed in claim 30, said bucket [Fig. 1, ref. 11; Paragraph 28] having a bottom tang [Fig. 10, ref. 24; Paragraph 54] formed from curved surfaces having more than one radius of curvature [Fig. 10, ref. R<sub>1</sub>, R<sub>13</sub>; Paragraph 54].

32. A bucket as claimed in claim 31, said bucket [Fig. 1, ref. 11; Paragraph 28] further including at least one straight surface [Fig. 2A, ref. 201; Paragraph 30].

33. A bucket as claimed in claim 31, said curved surfaces having radii of curvatures of .3762 inches and .5556 inches [Fig. 10, ref. R<sub>1</sub>, R<sub>13</sub>; Paragraph 54].

34. A bucket as claimed in claim 30, said bucket [Fig. 1, ref. 11; Paragraph 28] having an upper tang [Figs. 2A and 10, ref. 22; Paragraph 56] formed from curved surfaces having more than one radius of curvature [Fig. 2A, ref. 22, Fig. 10, ref. R<sub>5</sub>, R<sub>6</sub>; Paragraph 56].

35. A bucket as claimed in claim 31, said bucket [Fig. 1, ref. 11; Paragraph 28] having an upper tang [Figs. 2A and 10, ref. 22; Paragraph 56] formed from curved

surfaces having more than one radius of curvature [Fig. 2A ref. 22, Fig. 10, ref. R<sub>5</sub>, R<sub>6</sub>; Paragraph 56].

36. A bucket as claimed in claim 34, said bucket [Fig. 1, ref. 11; Paragraph 28] further including at least one straight surface [Fig. 2A, ref. 201; Paragraph 30].

37. A bucket as claimed in claim 30, said bucket [Fig. 1, ref. 11; Paragraph 28] having an intermediate tang [Figs. 2A and 10, ref. 23; Paragraph 56] formed from curved surfaces having more than one radius of curvature [Fig. 2A, ref. 23, Fig. 10, ref. R<sub>2</sub>, R<sub>3</sub>, R<sub>4</sub>, 205, 207; Paragraph 56].

38. A bucket as claimed in claim 31, said bucket [Fig. 1, ref. 11; Paragraph 28] having an intermediate tang [Figs. 2A and 10, ref. 23; Paragraph 56] formed from curved surfaces having more than one radius of curvature [Fig. 2A, ref. 23, Fig. 10, ref. R<sub>2</sub>, R<sub>3</sub>, R<sub>4</sub>, 205, 207; Paragraphs 31, 56].

39. A bucket as claimed in claim 35, said bucket [Fig. 1, ref. 11; Paragraph 28] having an intermediate tang [Figs. 2A and 10, ref. 23; Paragraph 56] formed from curved surfaces having more than one radius of curvature [Fig. 2A, ref. 23, Fig. 10, ref. R<sub>2</sub>, R<sub>3</sub>, R<sub>4</sub>, 205, 207; Paragraphs 31, 56].

40. A bucket as claimed in claim 37, said bucket [Fig. 1, ref. 11; Paragraph 28] further including at least one straight surface [Fig. 2A, ref. 201; Paragraph 30].

41. A turbine having multiple turbine stages, first and second turbine stages comprising:

a wheel [Fig. 1, ref. 10; Paragraph 28] having sixty broach slots [Fig. 1, ref. 12; Paragraph 28], each one of said broach slots having an interleaved system of fillets [Fig. 2B, ref. 31-33; Paragraphs 33-37] and tangs [Fig. 2B, ref. 28-30; Paragraphs 33-37]; and

a plurality of buckets [Fig. 1, ref. 11; Paragraph 28] each having a corresponding interleaved system of fillets [Fig. 2A, ref. 25-27; Paragraphs 29-32] and tangs [Fig. 2A, ref. 22-24; Paragraphs 29-32] so that said plurality of buckets [Fig. 1, ref. 11; Paragraph 28] can be fitted, one to one, into said sixty broach slots [Fig. 1, ref. 12; Paragraph 28] on said wheel [Fig. 1, ref. 10; Paragraph 28];

wherein said interleaved system of fillets and tangs on said buckets [Fig. 1, ref. 11; Paragraph 28] and broach slots [Fig. 1, ref. 12; Paragraph 28] act to reduce stresses acting on said fitted buckets [Fig. 1, ref. 11; Paragraph 28] and broach slots [Fig. 1, ref. 12; Paragraph 28], the fillets and tangs of said interleaved system of fillets and tangs each being formed by a combination of curved and straight surfaces [Figs. 2A and 2B, ref. 22-24, 25-27, 28-30, 31-33; Paragraphs 29-37];

wherein above the uppermost tang [Fig. 10, ref. 22; Paragraph 56] on each of said buckets [Fig. 1, ref. 11; Paragraph 28] there is a compound fillet [Fig. 10, ref. 25; Paragraph 56] having a first radius of curvature of 0.3342 inches and a second radius curvature of 0.0983 inches [Fig. 10, ref. R<sub>6</sub>, R<sub>6'</sub>; Paragraph 56].

42. The turbine as claimed in claim 41, wherein below the upper most tang [Fig. 10, ref. 22; Paragraph 56] on each of said buckets [Fig. 1, ref. 11; Paragraph 28] there is a fillet [Fig. 10, ref. 26; Paragraph 56] having a radius of curvature of 0.0741 inches [Fig. 10, ref. R<sub>4</sub>; Paragraph 56].

43. The turbine as claimed in claim 42, wherein above the bottom most tang [Fig. 10, ref. 24; Paragraphs 54 and 56] on each of said buckets [Fig. 1, ref. 11; Paragraph 28] there is a fillet [Fig. 10, ref. 27; Paragraph 56] having a radius of curvature of 0.0897 inches [Fig. 10, ref. R<sub>2</sub>; Paragraph 56].

44. A turbine having multiple turbine stages, first and second turbine stages comprising:

a wheel [Fig. 1, ref. 10; Paragraph 28] having sixty broach slots [Fig. 1, ref. 12; Paragraph 28], each one of said broach slots having an interleaved system of fillets [Fig. 2B, ref. 31-33; Paragraphs 33-37] and tangs [Fig. 2B, ref. 28-30; Paragraphs 33-37]; and

a plurality of buckets [Fig. 1, ref. 11; Paragraph 28] each having a corresponding interleaved system of fillets [Fig. 2A, ref. 25-27; Paragraphs 29-32] and tangs [Fig. 2A, ref. 22-24; Paragraphs 29-32] so that said plurality of buckets [Fig. 1, ref. 11; Paragraph 28] can be fitted, one to one, into said sixty broach slots [Fig. 1, ref. 12; Paragraph 28] on said wheel [Fig. 1, ref. 10; Paragraph 28];

wherein said interleaved system of fillets and tangs on said buckets [Fig. 1, ref. 11; Paragraph 28] and broach slots [Fig. 1, ref. 12; Paragraph 28] act to reduce stresses acting on said fitted buckets [Fig. 1, ref. 11; Paragraph 28] and broach slots

[Fig. 1, ref. 12; Paragraph 28], the fillets and tangs of said interleaved system of fillets and tangs each being formed by a combination of curved and straight surfaces [Figs. 2A and 2B, ref. 22-24, 25-27, 28-30, 31-33; Paragraphs 29-37];

wherein for each one of said plurality of buckets [Fig. 1, ref. 11; Paragraph 28] the distance from the bottom of the bottom most tang [Fig. 9, 24; Paragraph 51] to the upper most straight portion of the upper most fillet [Fig. 9, 25; Paragraph 51] is 1.9836 inches [Fig. 9, ref. L<sub>5</sub>; Paragraph 51].

45. The turbine as claimed in claim 44, wherein for each one of said plurality of buckets [Fig. 1, ref. 11; Paragraph 28] the distance from the bottom of the bottom most tang [Fig. 9, 24; Paragraph 51] to a first intersection point of tangent lines drawn along pressure faces of the tang [Fig. 9, 23; Paragraph 51] adjacent to the bottom most tang [Fig. 9, 24; Paragraph 51] is 0.8429 inches [Fig. 9, ref. L<sub>7</sub>; Paragraph 51].

48. The turbine as claimed in claim 44, wherein for each one of said plurality of buckets [Fig. 1, ref. 11; Paragraph 28] the angle between the upper most straight portion of the upper most fillet [Fig. 9, 25; Paragraph 51] and the upper most straight portion of the upper most tang [Fig. 9, 22; Paragraph 51] is 50 degrees [Fig. 9, ref. A; Paragraph 47].

49. The turbine as claimed in claim 45, wherein for each one of said plurality of buckets [Fig. 1, ref. 11; Paragraph 28] the angle between the upper most straight portion of the upper most fillet [Fig. 9, 25; Paragraph 51] and the upper most straight portion of the upper most tang [Fig. 9, 22; Paragraph 51] is 50 degrees [Fig. 9, ref. A; Paragraph 47].

52. A turbine having multiple turbine stages, first and second turbine stages comprising:

a wheel [Fig. 1, ref. 10; Paragraph 28] having sixty broach slots [Fig. 1, ref. 12; Paragraph 28], each one of said broach slots [Fig. 1, ref. 12; Paragraph 28] having an interleaved system of fillets [Fig. 2B, ref. 31-33; Paragraphs 33-37] and tangs [Fig. 2B, ref. 28-30; Paragraphs 27-29 and 33]; and

a plurality of buckets [Fig. 1, ref. 11; Paragraph 28] each having a corresponding interleaved system of fillets [Fig. 2A, ref. 25-27; Paragraphs 29-32] and tangs [Fig. 2A, ref. 22-24; Paragraphs 29-32] so that said plurality of buckets [Fig. 1, ref. 11; Paragraph 28] can be fitted, one to one, into said sixty broach slots [Fig. 1, ref. 12; Paragraph 28] on said wheel [Fig. 1, ref. 10; Paragraph 28];

wherein said interleaved system of fillets and tangs on said buckets [Fig. 1, ref. 11; Paragraph 28] and broach slots [Fig. 1, ref. 12; Paragraph 28] act to reduce stresses acting on said fitted buckets [Fig. 1, ref. 11; Paragraph 28] and broach slots [Fig. 1, ref. 12; Paragraph 28], the fillets and tangs of said interleaved system of fillets and tangs each being formed by a combination of curved and straight surfaces [Figs. 2A and 2B, ref. 22-24, 25-27, 28-30, 31-33; Paragraphs 29-37];

wherein below the uppermost tang [Fig. 12, ref. 28; Paragraph 65] on each of said broach slots there is a fillet [Fig. 12, ref. 31; Paragraph 65] having a radius of curvature of 0.0959 inches [Fig. 12, ref. R<sub>11</sub>; Paragraph 65].

53. The turbine as claimed in claim 52, wherein above the bottom most tang [Fig. 12, ref. 30; Paragraph 65] on each of said broach slots there is a fillet [Fig. 12, ref.



32; Paragraph 65] having a radius of curvature of 0.1037 inches [Fig. 12, ref. R<sub>9</sub>; Paragraph 65].

55. A turbine having multiple turbine stages, first and second turbine stages comprising:

a wheel [Fig. 1, ref. 10; Paragraph 28] having sixty broach slots [Fig. 1, ref. 12; Paragraph 28], each one of said broach slots [Fig. 1, ref. 12; Paragraph 28] having an interleaved system of fillets [Fig. 2B, ref. 31-33; Paragraphs 33-37] and tangs [Fig. 2B, ref. 28-30; Paragraphs 33-37]; and

a plurality of buckets [Fig. 1, ref. 11; Paragraph 28] each having a corresponding interleaved system of fillets [Fig. 2A, ref. 25-27; Paragraphs 29-32] and tangs [Fig. 2A, ref. 22-24; Paragraphs 29-32] so that said plurality of buckets can be fitted, one to one, into said sixty broach slots on said wheel;

wherein said interleaved system of fillets and tangs on said buckets [Fig. 1, ref. 11; Paragraph 28] and broach slots [Fig. 1, ref. 12; Paragraph 28] act to reduce stresses acting on said fitted buckets and broach slots, the fillets and tangs of said interleaved system of fillets and tangs each being formed by a combination of curved and straight surfaces [Fig. 1, ref. 10-12, Figs. 2A and 2B, ref. 12, 21, 22-24, 25-27, 28-30, 31-33; Paragraphs 27-37];

wherein for each one of said broach slots [Fig. 1, ref. 12; Paragraph 28] the distance from the bottom of the bottom most fillet [Fig. 11, ref. 33; Paragraph 61] to the upper most straight portion of the upper most tang [Fig. 11, ref. 28; Paragraph 61] is 1.9836 inches [Fig. 11, ref. L<sub>18</sub>; Paragraph 61].

56. The turbine as claimed in claim 55, wherein for each one of said broach slots [Fig. 1, ref. 12; Paragraph 28] the distance from the bottom of the bottom most fillet [Fig. 11, ref. 33; Paragraph 61] to a first intersection point of tangent lines drawn along pressure faces of the fillet [Fig. 11, ref. 32; Paragraph 61] adjacent to the bottom most fillet is 0.8433 inches [Fig. 11, ref. L<sub>20</sub>; Paragraph 61].

59. The turbine as claimed in claim 55, wherein for each one of said broach slots [Fig. 1, ref. 12; Paragraph 28] the angle between the upper most straight portion of the upper most tang [Fig. 11, ref. 28; Paragraphs 47 and 58] and the upper most straight portion of the upper most fillet [Fig. 11, ref. 31; Paragraphs 47 and 58] is 50 degrees [Fig. 11, ref. A; Paragraphs 47 and 58].

60. The turbine as claimed in claim 56, wherein for each one of said broach slots [Fig. 1, ref. 12; Paragraph 28] the angle between the upper most straight portion of the upper most tang [Fig. 11, ref. 28; Paragraphs 47 and 58] and the upper most straight portion of the upper most fillet [Fig. 11, ref. 31; Paragraphs 47 and 58] is 50 degrees [Fig. 11, ref. A; Paragraphs 47 and 58].

**(VI) GROUND OF REJECTION TO BE REVIEWED ON APPEAL**

A. Whether claims 10, 12-20 and 29-40 are properly rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. It is noted that the Examiner's rejection of claim 29 to the extent that "'said buckets' lacks antecedent basis" is not being appealed, that Appellant acquiesced in the rejection of claim 29 on this basis but asks that it be held in abeyance pending the Board's decision on the appealed issues in this case at which time Appellant will correct the antecedent basis problem in claim 29 in accordance with the Board's decision in this appeal. See Office action at page 3, last line.

B1. Whether claims 29-32 are anticipated under 35 U.S.C. §102(b) by Webb or

B2. Whether claims 29-32 are anticipated under 35 U.S.C. § 102(b) by Johnson.

C. Whether claims 10 and 13-19 would have been obvious under 35 U.S.C. §103(a) over Webb in view of By.

D. Whether claim 12 would have been obvious under 35 U.S.C. §103(a) over Webb and By in view of United Kingdom 677,142 (hereinafter "the '142 patent").

E. Whether claim 20 would have been obvious under 35 U.S.C. §103(a) over Webb and By in view of Caruso.

F. Whether claim 33 would have been obvious under 35 U.S.C. §103(a) over Webb.

G. Whether claims 34-40 would have been obvious under 35 U.S.C. §103(a) over Webb in view of Leonardi.

H. Whether claims 41-43 would have been obvious under 35 U.S.C. §103(a) over Pisz in view of By.

I. Whether claims 44-45, 55-56 and 59-60 would have been obvious under 35 U.S.C. §103(a) over Heinig in view of By.

J. Whether claims 48-49 would have been obvious under 35 U.S.C. §103(a) over Heinig and By in view of Phipps.

K. Whether claims 52-53 would have been obvious under 35 U.S.C. §103(a) over Johnson in view of By.

**(VII) ARGUMENT**

**A. Whether claims 10, 12-20 and 29-40 are properly rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.**

Claims 10 and 29 and their respective dependent claims 12-20 and 30-40 require a specific angular relationship between the center line of the bucket and a line defined by tangent lines drawn along the straight surfaces of each of the two uppermost tangs on each side of the bucket. Both of independent claims 10 and 29 require in relevant part:

wherein the straight surfaces of each of the two uppermost tangs on each side of a center line bisecting each of said buckets define two points of a respective line that form an angle of 20.782° with the center line; and . . .

This relationship is shown in Figure 10 where in viewing, for example, the right hand side of the bucket, tangent lines drawn along the straight surfaces of right hand tang 22 and right hand tang 23 (the two uppermost tangs) define two points of a line that forms an angle E with the centerline. The angle E (on each side of the bucket) formed by each of these two lines and the center line of bucket equals 20.782 degrees.

The Examiner has rejected claims 10 and 29 because he has misinterpreted the relevant claim language and implies that Appellant's requirement that "the straight surfaces of each of the two uppermost tangs on each side of a centerline bisecting each of the buckets" means that only the uppermost tang on each side of the bucket, i.e., tang 22 in Appellant's Figure 10 is utilized to "define a point of a line that forms an angle

of 20.782 degrees.” See, Office Action at pages 3-4 (emphasis in original) and the Examiner’s sketches of pages 5 and 7 therein. Thus the Examiner has misconstrued the claim language that requires the use of two tangs on each side of the bucket to define the line that forms angle E with the center line, as required by the above referenced relevant portion of claim 10.

Moreover, the Examiner’s interpretation of the claim language is also erroneous because a line cannot properly be defined by a single point and, by doing so, leads to the incongruous result illustrated by the Examiner’s annotated Figure 1 in the Office Action wherein it is possible to draw a line through the point determined by tangent lines of a single tang (i.e., tang 28) at any angle (including an angle of 20.782 degrees). But as shown in annotated Figure 1 the line drawn by the Examiner is not defined by tangent lines drawn using the two uppermost tangs 28 and 30 to define two points for defining the line, but by only using the single uppermost tang 28.

Accordingly, the Examiner’s rejections of claims 10, 12-20 and 29-40 on the basis that claims 10 and 29 should be amended to define a line utilizing a single point defined by tangent lines along a single tang is in error and should be reversed.

The Examiner has also rejected claim 12 stating that “fillets” is inaccurate and should be changed to --tangs--. Appellant respectfully submits that the Examiner is in error and that claim 12 is fully supported in the application by Figures 9 and 10, and paragraph 47 wherein the angles of fillets 25, 26 and 27 are given by angles A, B and F, respectively, as 50.000°, 56.087°, and 56.964°. Accordingly, the Examiner’s rejection of claim 12 is also in error and should be reversed.

Finally, the Examiner has rejected claim 29 because "buckets" lacks antecedent basis. As noted previously, Appellant acquiesces with this rejection but asks that it be held in abeyance until the Board's decision with regards to the appealed issues in this case, at which time Appellant will correct the antecedent basis problem in claim 29 in accordance with the Board's decision in the Appeal.

**B1. Whether claims 29-32 are anticipated under 35 U.S.C. § 102(b) by Webb.**

In rejecting claims 29-32 as being anticipated by Webb, the Examiner has made the same error in rejecting these claims under 35 U.S.C. 112, second paragraph, discussed above. Namely, the Examiner has erroneously used a single upper tang (one on each side of the bucket) to determine a single point used to define a line forming an angle of  $20.782^\circ$  with the center line of the bucket. See the Examiner's annotated sketch at page 5 of the Office Action dated October 16, 2007. If the two uppermost tangs of each reference are used, as required by the claim language, to define the line then the angle formed with the center line is less than  $14^\circ$  in Webb.

Appellant has used the two uppermost tangs in Webb to create Figure A, attached hereto in Evidence Appendix IX. As shown in Figure A, when the two uppermost tangs of Webb are used to define the line that forms an angle with the center line of its bucket, an angle of less than  $14^\circ$  results. Accordingly, Webb does not teach or suggest the angular relationship of  $20.782^\circ$  disclosed and claimed in the present application.

In applying Webb against these claims the Examiner only used the single uppermost tang of Webb to determine a single point of the line that forms the angle with the respective bucket's centerline -- the Examiner then simply drew the line through the single determined point to form an angle of 20.782°. See Examiner's annotated sketch at page 5 of the Office Action dated October 16, 2007. The Examiner's actions in this regard are not in accordance with the claim language which requires using the two uppermost tangs on each side of a centerline bisecting the bucket, thereby defining a single specific line that formed an angle of 20.782° with the bucket center line. As demonstrated above with reference to Figure A in Evidence Appendix IX, when the two uppermost tangs on each side of the bucket in Webb are used Appellant's claimed angular relationship of 20.782° between the specifically determined line and the centerline does not result.

In addition, it is noted that Webb utilizes key 24 (first embodiment) or key 50 (alternative embodiment) for locking and retaining the turbine rotor blades on the turbine wheel. See, Webb at Figures 1-8, column 1, lines 19-22, column 2, lines 60-66, and column 3, lines 32-75. Moreover, Webb states that "[i]t is to be understood that the particular slot and root form is immaterial." See, column 2, lines 23-24. Thus, Webb also does not teach or suggest the following limitation of claim 29:

wherein said interleaved system of fillets and tangs on said bucket and wheelpost act to reduce stresses acting along on said fitted bucket and wheelpost, the fillets and tangs of said interleaved system of fillets and tangs each being formed by a combination of curved and straight surfaces . . .



Since Webb states that “the particular slot and root form is immaterial” it is clear that it is relying on its disclosed locking keys for maintaining the rotor blades attached to the turbine wheel, and is not in any way concerned with, let alone disclosing, a system of interleaved fillets and tangs for reducing stresses acting along the fitted bucket and wheelpost, as required by claim 29.

Accordingly, claims 29-32 are believed to patentably define over Webb and the Examiner’s rejection of these claims as anticipated by this reference should be reversed.

**B2. Whether claims 29-32 are anticipated under 35 U.S.C. § 102(b) by Johnson.**

In rejecting claims 29-32 as being anticipated by Johnson, the Examiner has made the same error in rejecting these claims under 35 U.S.C. 112, second paragraph, discussed above. Namely, the Examiner has erroneously used a single upper tang (one on each side of the bucket) to determine a single point used to define a line forming an angle of  $20.782^\circ$  with the center line of the bucket. See the Examiner’s annotated sketch at page 7 of the Office Action dated October 16, 2007. If the two uppermost tangs of Johnson are used, as required by the claim language, to define the line then the angle formed with the center line is less than  $16^\circ$  in Johnson. Indeed, the Johnson reference discloses the angle formed by tangent line TN and center line RCL, shown in Figure 1, to be  $15.75^\circ$ . See Johnson at Figure 1 and column 4, lines 6-9.

Appellant has used the two uppermost tangs in Johnson to create Figure B, attached hereto in Evidence Appendix IX. Figure B utilizes the two uppermost tangs of

Johnson to define the line that forms an angle with the center line of its bucket to be less than  $16^{\circ}$ . Accordingly, Johnson does not teach or suggest the angular relationship of  $20.782^{\circ}$  disclosed and claimed in the present application.

In applying Johnson against these claims the Examiner only used the single uppermost tang of Johnson to determine a single point of the line that forms the angle with the respective bucket's centerline -- the Examiner then simply drew the line through the single determined point to form an angle of  $20.782^{\circ}$ . See the Examiner's annotated sketch at page 7 of the Office Action dated October 16, 2007. The Examiner's actions in this regard are not in accordance with the claim language which requires using the two uppermost tangs on each side of a centerline bisecting the bucket, thereby defining a single specific line that formed an angle of  $20.782^{\circ}$  with the bucket center line. As demonstrated above with reference to Figure B in Evidence Appendix IX, when the two uppermost tangs on each side of the bucket in Johnson are used Appellant's claimed angular relationship of  $20.782^{\circ}$  between the specifically determined line and the centerline does not result.

Accordingly, claims 29-32 are believed to patentably define over Johnson and the Examiner's rejection of these claims as anticipated by this reference should be reversed.

**C. Whether claims 10 and 13-19 would have been obvious under 35 U.S.C. § 103(a) over Webb in view of By.**

In rejecting claims 10 and 13-19 as being unpatentable over Webb in view of By, the Examiner has erroneously applied Webb as above with respect to claims 29-32. More particularly, as noted above, Webb does not teach or suggest the angular

relationship of  $20.782^\circ$  between the specifically determined line (using the two uppermost tangs on each side of the bucket) and the centerline required by independent claim 10.

Since By is directed to the profile of airfoil 10 and not to the profile of dovetail 16, it should be clear that it does not solve this deficiency of Webb. More particularly, By does not disclose any dimensions or angular relationships regarding the configuration of dovetail 16 and, therefore, also does not teach or suggest the required angular relationship of  $20.782^\circ$  between the specifically determined line (using the two uppermost tangs on each side of the bucket) and the center line required by independent claim 10.

Indeed, the Examiner has only cited By for disclosing first and second stages of a turbine having a wheel with sixty broach slots. Accordingly, it is respectfully submitted that claims 10 and 13-17 patentably define over Webb and By, taken singly or in combination, and that the Examiner's rejections of these claims should be reversed.

With respect to the rejection of claims 18 and 19 the Examiner alleges that the specific dimensions given for the bottom tang and bottom fillet, respectively, are mere "matters of choice in design" and cites to *In re Boesch*, 617 F.2d 272 (CCPA 1980) for support of his assertion. However, *In re Boesch* involved a chemical composition case in which there were overlapping ranges between the claimed constituents and those disclosed in the prior art. In addition, the cited case involved an alleged unexpected result for the concentration of a single constituent material. Neither of these factors are present here and, accordingly, the case law cited by the Examiner is inapposite. Claims 18 and 19 require specific dimensions for specific structures, and do not merely recite

ranges. Moreover, these claims recite multiple specific dimensions and configurations for multiple structures from among an infinite number of possibilities for the dimensions and angular relationships of the specific tangs and fillets. The Supreme Court's recent *KSR* decision, stated:

When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense. In that instance the fact that a combination was obvious to try might show that it was obvious under §103.

*KSR Int'l v. Teleflex, Inc.*, 550 U.S. \_\_\_\_ (2007) at p.17 (emphasis supplied). Thus, under *KSR* Appellants' invention would not have been obvious, since there were virtually an infinite number of options for the specific number, angular relationships between, and dimensions of the tangs and fillets of the buckets and wheelposts the specific relationships and dimensions arrived at in these claims and not a finite number of identified, predictable solutions.

For all of these reasons it is improper for the Examiner to allege that the specific recitations of these claims are mere matters of design choice. Accordingly, claims 18 and 19 are believed to further patentably define over the cited art, taken singly or in combination.

**D. Whether claim 12 would have been obvious under 35 U.S.C. § 103(a) over Webb and By in view of the '142 patent.**

In rejecting claim 12, the Examiner has relied on a combination of Webb, By and the '142 patent. As noted above, neither Webb nor By teach or suggest the required

angular relationship of  $20.782^\circ$  between the specifically determined line (using the two uppermost tangs on each side of the bucket) and the center line of the bucket as required by independent claim 10 from which claim 12 depends. Since, the '142 patent has only been cited for disclosing "bucket tangs having an angle of 55 degrees" it should be clear that this reference does not solve the deficiency noted above regarding the required angular relationship of  $20.782^\circ$ . Indeed, Figure 1 of the '142 patent clearly indicates that the required angular relationship would be only  $15^\circ$  (i.e., half of the  $30^\circ$  angle shown in Figure 1 of the '142 patent). Accordingly, it is respectfully submitted that claim 12 patentably defines over Webb, By and the '142 patent, taken singly or in any combination, and that the Examiner's rejection of this claim should be reversed.

**E. Whether claim 20 would have been obvious under 35 U.S.C. § 103(a) in view of Caruso.**

In rejecting claim 20, over a combination of Webb, By and Caruso, the Examiner merely cites Caruso for disclosing that the "outer tang edge of each wheelpost is scalloped." Thus, it should be clear that Caruso does not solve the deficiencies noted above with respect to Webb and By. Namely, none of these three references teaches or suggest the required angular relationship of independent claim 10 from which claim 20 depends. Accordingly, claim 20 is believed to patentably define over the cited art taken singly or in combination.

Moreover, Caruso does not teach anywhere in its disclosure that it is providing scalloped wheelposts as required by claim 20. Caruso is concerned with a system that provides for the final bucket to be radially inserted into the wheelpost thereby allowing interlocking covers 18 to mate with each other. See, Caruso at Figures 1-3 and column

3, line 32 to column 4, line 22. There is simply no mention anywhere in Caruso of providing scalloped wheelposts to reduce the weight of the wheel, as required by claim 20. Apparently, the Examiner has misinterpreted Figure 1 (the only figure directed to the wheel in Caruso) as showing “scalloped tangs.” Figure 1 merely shows two protrusions, i.e., additional material not removed material, on the outer tang of wheel 10 and does not otherwise describe or even identify these protrusions with a reference numeral anywhere in its specification.

Accordingly, it is respectfully submitted that, absent the hindsight provided by Appellant’s application, those skilled in the art would not have considered the protrusions or the Caruso reference as disclosing scalloped wheelposts. Therefore, claim 20 is believed to patentably define over the cited references for this additional reason.

**F. Whether claim 33 would have been obvious under 35 U.S.C.**

**§ 103(a) over Webb.**

In rejecting claim 33 as being unpatentable over Webb the Examiner asserts that the specific dimensions given for the bottom tang is a mere “matter of choice in design” and cites to *In re Boesch*, 617 F.2d 272 (CCPA 1980) for support of his assertion. However, as previously noted, *In re Boesch* involved a chemical composition case in which there were overlapping ranges between the claimed constituents and those disclosed in the prior art. In addition, the cited case law involved an alleged unexpected result for the concentration of a single constituent material. Neither of these factors are present here and, accordingly, the case law cited by the Examiner is inapposite.

Claim 33 requires specific dimensions for specific structures, and does not merely recite ranges. Moreover, this claim recites multiple specific dimensions and configurations for multiple structures from among an infinite number of possibilities for the dimensions and angular relationships of the specific tangs and fillets and thus does not meet the requirement of a finite number of identified, predictable solutions as set forth in the Supreme Court’s *KSR* decision. For all of these reasons it is improper for the Examiner to allege that the specific recitations of claim 33 is a mere matter of design choice. Accordingly, claim 33 is believed to further patentably define over the cited art and, therefore, the Examiner’s rejection of the claim should be reversed.

Moreover, as noted above, Webb fails to teach or suggest the specific angular relationship required in claim 29 from which claim 33 depends. Accordingly, claim 33 is believed to also patentably define over Webb by virtue of its dependency from claim 29.

**G. Whether claims 34-40 would have been obvious under 35 U.S.C.**

**§ 103(a) over Webb in view of Leonardi.**

In rejecting claims 34-40 the Examiner has relied on a combination of Webb and Leonardi. As noted above, Webb does not teach or suggest the required angular relationship of 20.782° between the specifically determined line (using the two uppermost tangs on each side of the bucket) and the centerline in independent claim 10 from which claim 12 depends. Since Leonardi has only been cited for disclosing tangs formed from curved surfaces with more than one radii of curvature, it should be clear that this reference does not solve the deficiency of Webb noted above regarding the required angular relationship of 20.782°. Accordingly, it is respectfully submitted that claims 34-40 patentably define over Webb and Leonardi, taken singly or in combination, and that the Examiner's rejection of these claims should be reversed.

**H. Whether claims 41-43 would have been obvious under 35 U.S.C.**

**§ 103(a) over Pisz in view of By.**

The Examiner admits that neither Pisz nor By disclose the specific dimensional relationships for the fillets and tangs as required by claims 41-43. In rejecting the claims the Examiner improperly asserts that the specific dimensions given for the fillets and tangs in claims 41-43 are mere "matters of choice in design" and cites to *In re Boesch*, 617 F.2d 272 (CCPA 1980) for support of his assertion. However, as previously noted, *In re Boesch* involved a chemical composition case in which there were overlapping ranges between the claimed constituents and those disclosed in the prior art. In addition, the cited case law involved an alleged unexpected result for the concentration of a single constituent material. Neither of these factors are present here



and, accordingly, the case law cited by the Examiner is inapposite. Moreover, while *KSR*, as discussed above, holds that a finite number of identified, predictable solutions within the technical grasp of one skilled in the art might have been obvious to try this is not the case here.

Claims 41-43 require specific dimensions for specific structures, and do not merely recite ranges. Moreover, the dependant claims 42-43 recite multiple specific dimensions and configurations for multiple structures from among an infinite number of possibilities for the dimensions and angular relationships of the specific tangs and fillets. For all of these reasons it is improper for the Examiner to allege that the specific recitations of claims 41-43 are mere matters of design choice. Accordingly, claims 41-43 are believed to patentably define over the cited art, taken either singly or in combination, and, therefore, the Examiner's rejection of the claims should be reversed.

**I. Whether claims 44-45, 55-56 and 59-60 would have been obvious under 35 U.S.C. § 103(a) over Heinig in view of By.**

The Examiner admits that neither Heinig nor By disclose the specific dimensional relationships for the fillets and tangs as required by claims 44-45, 55-56 and 59-60. In rejecting the claims the Examiner improperly asserts that the specific dimensions given for the fillets and tangs in these claims are mere matters of choice in design, and cites to *In re Boesch*, 617 F.2d 272 (CCPA 1980) for support of his assertion. However, as previously noted, *In re Boesch* involved a chemical composition case in which there were overlapping ranges between the claimed constituents and those disclosed in the prior art. In addition, the cited case law involved an alleged unexpected result for the concentration of a single constituent material. Neither of these factors are present here

and, accordingly, the case law cited by the Examiner is inapposite. Moreover, while *KSR*, as discussed above, holds that a finite number of identified, predictable solutions within the technical grasp of one skilled in the art might have been obvious to try this is not the case here.

Each of the rejected claims require specific dimensions for specific structures, and do not merely recite ranges. Moreover, the dependant claims 45, 56, 59 and 60 require multiple specific dimensions and configurations for multiple structures from among an infinite number of possibilities for the dimensional relationships of the specific tangs and fillets. For all of these reasons it is improper for the Examiner to allege that the specific recitations of these claims are mere matters of design choice. Accordingly, claims 44-45, 55-56 and 59-60 are believed to patentably define over the cited art, taken either singly or in combination, and, therefore, the Examiner's rejection of the claims should be reversed.

**J. Whether claims 48-49 would have been obvious under 35 U.S.C. § 103(a) over Heinig and By in view of Phipps.**

In rejecting claims 48-49 the Examiner has applied Phipps in combination with Heinig and By. The Examiner admits that none of the cited references discloses any of the specific dimensions for the tangs and fillets required by the rejected claims.

Indeed, Phipps is only being cited for disclosing 55° for the angle between the upper most straight portion of the upper most fillet and the upper most straight portion of the upper most tang instead of the required angle of 50° in claims 48 and 49. Moreover, Phipps does not even disclose the Examiner's alleged angle of 55° anywhere in its specification. Nor is there any figure in Phipps from which an accurate measurement of

the angle could be obtained – Figures 1 and 2 are perspective drawings and Figure 3 is a partial drawing that does not even show the upper fillet and tang from which the required angle could be measured.

Since none of the cited references teach or suggest the specific dimensional and angular relationships of the tangs and fillet required by claims 48 and 49, these claims are believed to patentably define over the cited art taken singly or in combination.

**K. Whether claims 52-53 would have been obvious over Johnson in view of By.**

In rejecting these claims the Examiner has misapplied the cited art. More particularly, the Examiner is asserting bucket dimensions disclosed in Johnson against broach slot dimensions required by claims 52-53. Moreover, the Examiner alleges that compound radii R3 and R4 (equal to each other, but applied from different points taken along a centerline of the tang) for the dimensioning of the upper tang of the bucket, as shown in Figure 1 of Johnson, somehow reads onto the single radius of curvature required for the fillet recited in claim 52 (i.e., R11 as shown in Fig. 12 and described at paragraph 65 of Appellant's application).

Nowhere does Johnson teach or suggest the single radius of curvature required for the fillet in claim 52. Nowhere does Johnson teach or suggest the single radius of curvature required for the fillet in claim 53. Finally, as noted above, By clearly does not overcome these deficiencies of Johnson since it merely discloses profile dimensions for turbine blades not dovetails, and it has merely been cited for disclosing a turbine wheel having sixty buckets.

Finally, it should be pointed again, that the dimensions for the tangs and fillets required in these claims are not merely design choices, and that the Examiner's case law citation to *In re Boesch* is inapposite here, for the same reasons given above. Moreover, while *KSR*, as discussed above, holds that a finite number of identified, predictable solutions within the technical grasp of one skilled in the art might have been obvious to try this is not the case here.

Accordingly, claims 52-53 are believed to patentably define over the cited art, taken either singly or in combination, and, therefore, the Examiner's rejection of the claims should be reversed.


### **CONCLUSION**

In conclusion it is believed that the application is in clear condition for allowance; therefore, early reversal of the rejection of all appealed claims and passage of the subject application to issue are earnestly solicited.

LAGRANGE et al.  
Serial No. 10/774,400

Respectfully submitted,

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**(VIII) CLAIMS APPENDIX**

10. A turbine having multiple turbine stages, first and second turbine stages comprising:

a wheel having sixty broach slots, each one of said broach slots having an interleaved system of fillets and tangs; and

a plurality of buckets each having a corresponding interleaved system of fillets and tangs so that said plurality of buckets can be fitted, one to one, into said sixty broach slots on said wheel;

wherein said interleaved system of fillets and tangs on said buckets and wheelposts act to reduce stresses acting on said fitted buckets and wheelposts, the fillets and tangs of said interleaved system of fillets and tangs each being formed by a combination of curved and straight surfaces;

wherein the straight surfaces of each of the two uppermost tangs on each side of a center line bisecting each of said buckets define two points of a respective line that form an angle of  $20.782^\circ$  with the center line; and;

wherein a point defined by intersecting tangent lines along pressure faces of the bottom most tang does not lie on either line that forms the angle of  $20.782^\circ$  with the center line.

12. A turbine as claimed in claim 10, wherein the fillets formed on said plurality of buckets have angles ranging from  $50^\circ$  to  $57^\circ$ .

13. A turbine as claimed in claim 10, each one of said buckets and wheelposts having three interleaved tangs and fillets.
14. A turbine as claimed in claim 13, wherein each of said buckets having a bottom tang formed from curved surfaces having more than one radius of curvature.
15. A turbine as claimed in claim 14, wherein each of said buckets further includes at least one straight surface.
16. A turbine as claimed in claim 10, wherein each of said wheelposts having a bottom fillet formed from curved surfaces having more than one radius of curvature.
17. A turbine as claimed in claim 16, wherein each of said wheelposts further includes at least one straight surface.
18. A turbine as claimed in claim 14, wherein said curved surfaces have radii of curvatures of .3762 inches and .5556 inches.
19. A turbine as claimed in claim 16, wherein said curved surfaces have radii of curvatures of .3822 inches and .5616 inches.
20. A turbine as claimed in claim 10, wherein a top surface of each one of said wheelposts being scalloped so as to reduce the weight of said wheel.

29. A bucket for insertion into a wheelpost of a turbine rotor, said bucket being formed from interleaved fillets and tangs which complement interleaved fillets and tangs formed in the wheelpost,

wherein said interleaved system of fillets and tangs on said buckets and wheelposts act to reduce stresses acting on said fitted buckets and wheelposts, the fillets and tangs of said interleaved system of fillets and tangs each being formed by a combination of curved and straight surfaces;

wherein the straight surfaces of each of the two uppermost tangs on each side of a center line bisecting each of said buckets define two points of a respective line that form an angle of  $20.782^\circ$  with the center line; and

wherein a point defined by intersecting tangent lines along pressure faces of the bottom most tang does not lie on either line that forms the angle of  $20.782^\circ$  with the center line.

30. A bucket as claimed in claim 29, said bucket having three interleaved tangs and fillets.

31. A bucket as claimed in claim 30, said bucket having a bottom tang formed from curved surfaces having more than one radius of curvature.

32. A bucket as claimed in claim 31, said bucket further including at least one straight surface.



33. A bucket as claimed in claim 31, said curved surfaces having radii of curvatures of .3762 inches and .5556 inches.

34. A bucket as claimed in claim 30, said bucket having an upper tang formed from curved surfaces having more than one radius of curvature.

35. A bucket as claimed in claim 31, said bucket having an upper tang formed from curved surfaces having more than one radius of curvature.

36. A bucket as claimed in claim 34, said bucket further including at least one straight surface.

37. A bucket as claimed in claim 30, said bucket having an intermediate tang formed from curved surfaces having more than one radius of curvature.

38. A bucket as claimed in claim 31, said bucket having an intermediate tang formed from curved surfaces having more than one radius of curvature.

39. A bucket as claimed in claim 35, said bucket having an intermediate tang formed from curved surfaces having more than one radius of curvature.

40. A bucket as claimed in claim 37, said bucket further including at least one straight surface.

41. A turbine having multiple turbine stages, first and second turbine stages comprising:

a wheel having sixty broach slots, each one of said broach slots having an interleaved system of fillets and tangs; and

a plurality of buckets each having a corresponding interleaved system of fillets and tangs so that said plurality of buckets can be fitted, one to one, into said sixty broach slots on said wheel;

wherein said interleaved system of fillets and tangs on said buckets and broach slots act to reduce stresses acting on said fitted buckets and broach slots, the fillets and tangs of said interleaved system of fillets and tangs each being formed by a combination of curved and straight surfaces;

wherein above the uppermost tang on each of said buckets there is a compound fillet having a first radius of curvature of 0.3342 inches and a second radius curvature of 0.0983 inches.

42. The turbine as claimed in claim 41, wherein below the upper most tang on each of said buckets there is a fillet having a radius of curvature of 0.0741 inches.

43. The turbine as claimed in claim 42, wherein above the bottom most tang on each of said buckets there is a fillet having a radius of curvature of 0.0897 inches.

44. A turbine having multiple turbine stages, first and second turbine stages comprising:

a wheel having sixty broach slots, each one of said broach slots having an interleaved system of fillets and tangs; and

a plurality of buckets each having a corresponding interleaved system of fillets and tangs so that said plurality of buckets can be fitted, one to one, into said sixty broach slots on said wheel;

wherein said interleaved system of fillets and tangs on said buckets and broach slots act to reduce stresses acting on said fitted buckets and broach slots, the fillets and tangs of said interleaved system of fillets and tangs each being formed by a combination of curved and straight surfaces;

wherein for each one of said plurality of buckets the distance from the bottom of the bottom most tang to the upper most straight portion of the upper most fillet is 1.9836 inches.

45. The turbine as claimed in claim 44, wherein for each one of said plurality of buckets the distance from the bottom of the bottom most tang to a first intersection point of tangent lines drawn along pressure faces of the tang adjacent to the bottom most tang is 0.8429 inches.

46. The turbine as claimed in claim 45, wherein for each one of said plurality of buckets the distance from the bottom of the bottom most tang to a second intersection point of tangent lines drawn along pressure faces of the upper most tang is 1.2588 inches.

47. The turbine as claimed in claim 46, wherein for each one of said plurality of buckets the distance from the bottom of the bottom most tang to a point defined by the intersection of a line through said first and second intersection points and a tangent line along an upper straight surface of the bottom most tang is 0.4177 inches.

48. The turbine as claimed in claim 44, wherein for each one of said plurality of buckets the angle between the upper most straight portion of the upper most fillet and the upper most straight portion of the upper most tang is 50 degrees.

49. The turbine as claimed in claim 45, wherein for each one of said plurality of buckets the angle between the upper most straight portion of the upper most fillet and the upper most straight portion of the upper most tang is 50 degrees.

50. The turbine as claimed in claim 46, wherein for each one of said plurality of buckets the angle between the upper most straight portion of the upper most fillet and the upper most straight portion of the upper most tang is 50 degrees.

51. The turbine as claimed in claim 47, wherein for each one of said plurality of buckets the angle between the upper most straight portion of the upper most fillet and the upper most straight portion of the upper most tang is 50 degrees.

52. A turbine having multiple turbine stages, first and second turbine stages comprising:

a wheel having sixty broach slots, each one of said broach slots having an interleaved system of fillets and tangs; and

a plurality of buckets each having a corresponding interleaved system of fillets and tangs so that said plurality of buckets can be fitted, one to one, into said sixty broach slots on said wheel;

wherein said interleaved system of fillets and tangs on said buckets and broach slots act to reduce stresses acting on said fitted buckets and broach slots, the fillets and tangs of said interleaved system of fillets and tangs each being formed by a combination of curved and straight surfaces;

wherein below the uppermost tang on each of said broach slots there is a fillet having a radius of curvature of 0.0959 inches.

53. The turbine as claimed in claim 52, wherein above the bottom most tang on each of said broach slots there is a fillet having a radius of curvature of 0.1037 inches.

54. The turbine as claimed in claim 53, wherein below the bottom most tang on each of said broach slots there is a compound fillet having a first radius of curvature of 0.1248 inches and a second radius of curvature of 0.3822 inches, the first radius of curvature being measured from two points equally offset 0.0327 inches from either side of a center line bisecting each of said broach slots and at a distance of 0.3852 inches from the bottom of said compound fillet, and the second radius of curvature being

measured from the center line bisecting each of said broach slots at a distance of 0.5616 inches from the bottom of said compound fillet.

55. A turbine having multiple turbine stages, first and second turbine stages comprising:

a wheel having sixty broach slots, each one of said broach slots having an interleaved system of fillets and tangs; and

a plurality of buckets each having a corresponding interleaved system of fillets and tangs so that said plurality of buckets can be fitted, one to one, into said sixty broach slots on said wheel;

wherein said interleaved system of fillets and tangs on said buckets and broach slots act to reduce stresses acting on said fitted buckets and broach slots, the fillets and tangs of said interleaved system of fillets and tangs each being formed by a combination of curved and straight surfaces;

wherein for each one of said broach slots the distance from the bottom of the bottom most fillet to the upper most straight portion of the upper most tang is 1.9836 inches.

56. The turbine as claimed in claim 55, wherein for each one of said broach slots the distance from the bottom of the bottom most fillet to a first intersection point of tangent lines drawn along pressure faces of the fillet adjacent to the bottom most fillet is 0.8433 inches.

57. The turbine as claimed in claim 56, wherein for each one of said broach slots the distance from the bottom of the bottom most fillet to a second intersection point of tangent lines drawn along pressure faces of the upper most fillet is 1.2592 inches.

58. The turbine as claimed in claim 57, wherein for each one of said broach slots the distance from the bottom of the bottom most fillet to a point defined by the intersection of a line through said first and second intersection points and a tangent line along an upper straight surface of the bottom most fillet is 0.4181 inches.

59. The turbine as claimed in claim 55, wherein for each one of said broach slots the angle between the upper most straight portion of the upper most tang and the upper most straight portion of the upper most fillet is 50 degrees.

60. The turbine as claimed in claim 56, wherein for each one of said broach slots the angle between the upper most straight portion of the upper most tang and the upper most straight portion of the upper most fillet is 50 degrees.

61. The turbine as claimed in claim 57, wherein for each one of said broach slots the angle between the upper most straight portion of the upper most tang and the upper most straight portion of the upper most fillet is 50 degrees.

62. The turbine as claimed in claim 58, wherein for each one of said broach slots the angle between the upper most straight portion of the upper most tang and the upper most straight portion of the upper most fillet is 50 degrees.



**(IX) EVIDENCE APPENDIX**

Figures A and B. Office Action dated October 16, 2007.

# FIGURE A

Aug. 24, 1965

JAMES E. WEBB  
ADMINISTRATOR OF THE NATIONAL AERONAUTICS  
AND SPACE ADMINISTRATION

3,202,398

LOCKING DEVICE FOR TURBINE ROTOR BLADES

Filed Nov. 5, 1962

2 Sheets-Sheet 1

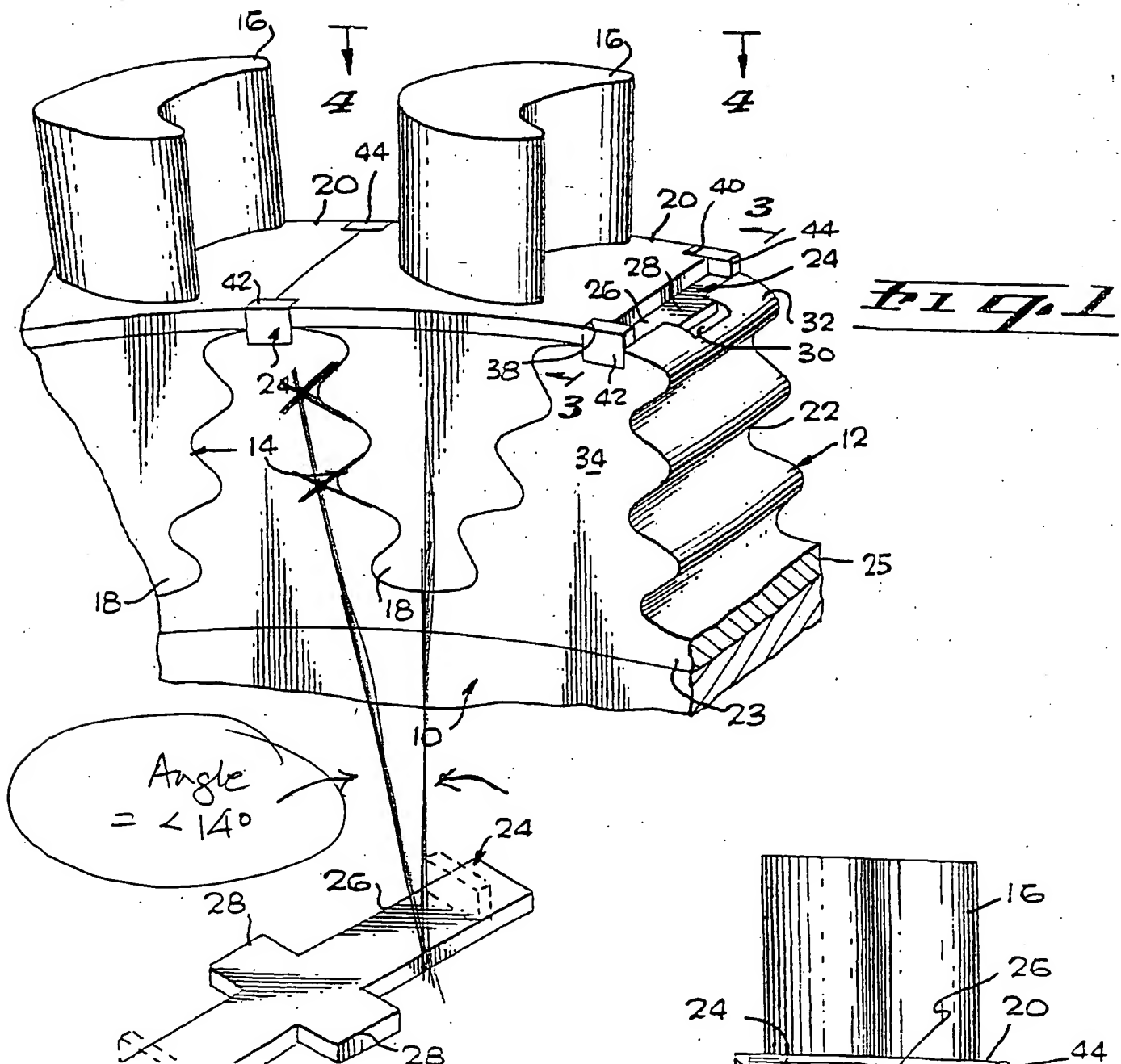
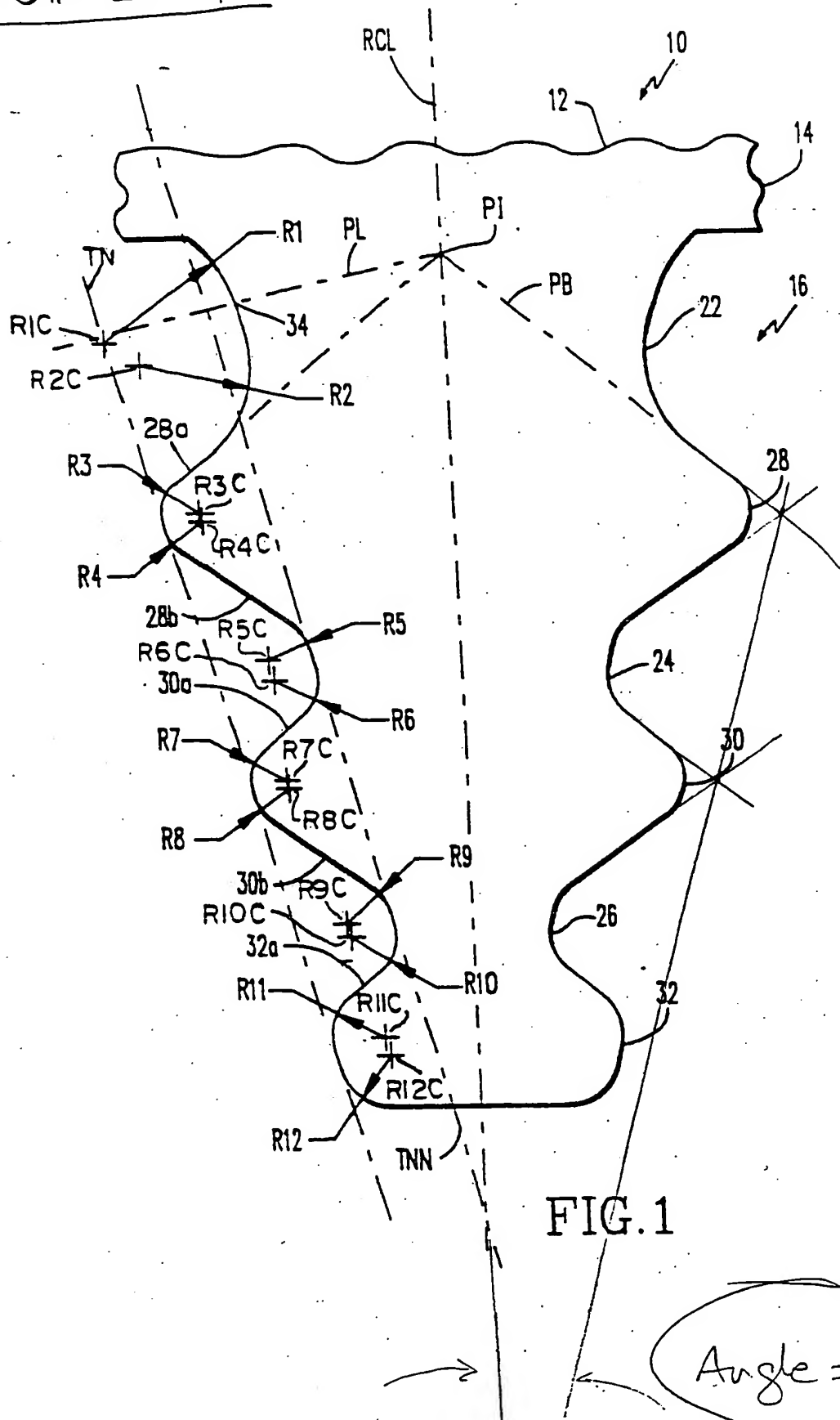


FIGURE B



**(X) RELATED PROCEEDINGS APPENDIX**

None.